5. References

Andreoni, James, "Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence" *Journal of Political Economy*, vol.97, no.6, 1447-1458, 1989

Atkinson, S.C., T.D. Crocker, and J.F. Shogren, Bayesian Exchangeability, Benefit Transfer, and Research Efficiency, "Water *Resources Research* March, 1992, Vol. 28:3, pp. 715-722.

Bostrom, Ann, Baruch Fischhoff, and M. Granger Morgan, "Characterizing Mental Models of Hazardous Processes: A Methodology and an Application to Radon." *Journal of Social Issues*, Vol. 48, No. 4, 1992, pp. 85-100.

Boyle, K.J. and J.C. Bergstrom, 1992. "Benefit Transfer Studies: Myths, Pragmatism, and Idealism," *Water Resources Research*, Vol. 28:3, pp. 657-663.

Boyle, Kevin J. "A Review of Contingent-Valuation Studies of the Benefits of Groundwater Protection" Center for Economics Research, Research Triangle Institute, Research Triangle Park, NC, draft report to USEPA, April 1993

Brookshire, D. and H. Neill, 1992. "Benefit Transfers: Conceptual and Empirical Issues," 2. "Benefit Transfer Studies: Myths, Pragmatism, and Idealism," Water *Resources Research* Vol. 28:3, pp. 651-656.

Brookshire, David S., Ralph C. d'Arge, "Experiments in Valuing Non-marketed Goods: A Case Study of Alternative Benefit Measures of Air Pollution Control in the South Coast Air Basin of southern California," in Methods Development for Assessing Tradeoffs in Environmental Management, vol. 2 EPA-60076-79-0016, Washington D. C., NTIS, 1979

Carlson, Bruce W., "Anchoring and Adjustment in Judgments Under Risk," *Journal of Experimental Psychology*, Vol. 16:4, 1990. p 665.

Coursey, D., J. Hovis, and W.D. Schulze, "On the Supposed Disparity Between Willingness to Accept and Willingness to Pay Measures of Value," *Quarterly Journal of Economics*, 679-690, 1987.

Desvousges, W. H., M.C. Naughton, and G.R. Parsons, "Benefit Transfer: Conceptual Problems in Estimating Water Quality Benefits Using Existing Studies," *Water Resources Research* Vol. 28:3, pp. 675-683.

Edwards, Steven F. "Option Prices for Groundwater Protection", *Journal of Environmental Economics and Management*, 15, 475-487, 1988

Fischhoff, B. and L. Furby "Measuring Values: A Conceptual Framework for Interpreting Transactions with Special Reference to Contingent Valuation of Visibility," *Journal of Risk and Uncertainty*, Vol. 1:147-184. 1988

Freeman, M.A., "Non-Use Values in Natural Resource Damage Assessment" Natural Resources Damages: Law and Economics, 1992

Greenley, Douglas A., Walsh, Richard G. and Young, Robert A., "Option Value: Empirical Evidence from a Case Study of Recreation and Water Quality", Quarterly *Journal of Economics*, November 1981, Vol. 96. No. 4, 657-673.

Greenley, Douglas A., Walsh, Richard G. and Young, Robert A., Economic Benefits of Improved Water Quality: Public Perceptions of Opton and Preservation Values, Westview Press. Boulder, Colorado, 1982

Hansen, M. H., W.G. Madow and B.J. Tepping, "An Evaluation of model-dependent and probability-sampling inferences in sample Surveys," *Journal of the American Statistical Association* , 78:776-807.

Howe, Charles W. 'The Impact of Price on Residential Water Demand: Some New Insights" *Water Resources Research*, Vol. 18, No. 4, PP. 713-716, August 1982

IEc, "Chapter 11: Non-Use Benefits of Ground Water Remediation" internal working draft, 17 December 1992, Industrial Economics, Incorporated, Cambridge, MA

Kahneman, Daniel, "Reference Points, Anchors, Norms, and Mixed Feelings," *Organizational Behavior and Human Decision Processes*, Vol 51, 1992, pp. 296-312.

Laze, Jeffrey K., William D. Schulze and Gary H. McClelland, "Economic Theory and Psychology of Non-Use Values" working paper, University of Colorado, 1993

Loomis, J. B., 'The Evolution of a More Rigorous Approach to Benefit Transfer: Benefit Function Transfer," *Water Resources Research*, March, 1992, Vol. 28:3, pp. 701-705.

Madariaga, B. and K.J. McConnell, May 1987, "Exploring Existence Values", *Water Resources Research*, Vol. 23:5:936-941.

McClelland, Gary H., William D. Schulze, Jeffrey K. Laze, Donald M. Waldman, James K. Doyle, Steven R. Elliott and Julie R. Irwin "Methods for

Measuring Non-Use Values: A Contingent Valuation Study of Groundwater Cleanup", October 1992 Draft report to USEPA

McClelland, Gary, William Schulze, and Brian Hurd, 'The Effect of Risk Beliefs on Property Values: A Case Study of a Hazardous Waste Site," *Risk Analysis*, 1990

McClelland, Gary, William Schulze, Donald Waldman, Julie Irwin, David Schenk, Thomas Stewart, Leland Deck. Mark Thayer, 'Valuing Eastern Visibility A Field Test of the Contingent Valuation Method, USEPA Cooperative Agreement CR-8 15183, June 1991.

Mitchell, Robert Cameron and Richard T. Carson "Existence Values for Groundwater Protection", Draft final report to USEPA, Resources for the Future, May 1989

Nieswiadomy, Michael "Estimating Urban Residential Water Demand: Effects of Price Structure, Conservation, and Education" *Water Resources Research*, Vol. 28,' No. 3, pp. 609-615, March 1992

Northcraft, Gregory B, and Margaret A. Neal, "Experts, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions," *Organizational Behavior and Human Decision* Processes 39, 84-97, 1987.

Poe, Gregory L. and Richard C. Bishop, "Application of a Convolutions Approach to Measuring Differences in Benefit Measures from Dichotomous Choice Contingent Valuation." Selected paper, American Agricultural Economics Association Annual Meetings, 1992

Roth, Emilie, M. Granger Morgan, Baruch Fischhoff, Lester Lave, and Ann Bostrom 'What Do We Know About Making Risk Comparisons?" *Risk Analysis*, Vol. 10, No. 3, pp. 375-387, 1990

Sarnadal, C. E., 1978. "Design-based and model based inference in survey sampling." *Scandinavian J. of Statistics*, 5:25-52.

Schulze, W. D., D.J. Schenk, S.R. Elliott, R.R. Boyce, J.R. Irwin, T. Stewart, P. Slovic, L. Deck and M. Thayer. Field and Laboratory Experiments on the Reliability of the Continent Valuation Method, USEPA Cooperative Agreement #CR-812054, May, 1989.

Schulze, William, Gary McClelland, Donald Waldman, Julie Irwin, Thomas Stewart, Leland Deck. Paul Slovic, Mary Thayer, "Valuing Visibility A Field Test of the Contingent Valuation Method, USEPA Report, Cooperative Agreement CR-812054, March 1990.

Seller, Christine, John R. Stoll, Jean-Paul Chavas, "Validation of Empirical Measures of Welfare Champs: A Comparison of Non-market Techniques." Land Economics Vol, No. 2, Mary 1985.

Smith, T.M.F. 1983. "On the validity of inferences on non-random samples." *J. of the Royal Stat. Sot.*. 146, *series* A:394-403.

Smith, V.K. and W.H. Desvousges, "The Value of Avoiding a LULU: Hazardous Waste Disposal Sites" *ReStat*, 1986

Smith, V. K., 1992, "On Separating Defensible Benefit Transfers From "Smoke and Mirrors", *Water Resources Research*, Vol. 28:3, pp.685-693.

Tolley, George S., and Alan Randall, with G. Blomquist, M. Brien, R. Fabian, M. Grenchik, G. Fishelson, A. Frankel, J. Hoehn, A. Kelly, R Krumm, E. Mensah, and T. Smith, Establishing and Valuing the Effects of Improved Visibility in the Eastern United States, final report to the U.S. Environmental Protection Agency, 1985

Tversky, A., and Kahneman, D., "Judgment Under Uncertainty Heuristics and Biases" Science, 1985, pp. 1124-1131.

6. Appendices

6A. POST-TEST QUESTION ON TEMPORAL ASPECTS OF VALUATION

Q19. **Each site requires different levels and types of cleanup technology. Some sites will be cleaned up quickly while others may takes years to clean up due to different types of contaminants and varying soil and water conditions. When you indicated how much you are willing to pay for cleanup, how long did you expect the cleanup to take?**

Q20 **Of the dollar amount you stated you are willing to pay on your monthly water bill for the next tens years for complete cleanup, what percent would you be willing to pay if you were now informed that cleanup would be <u>completed</u> ten (1 O) years from now?**

O% 5% 10% 20% 25% 30% 40% 60% 60% 70% 75% 60% 90% 100% 125% 150% 200% 250%+

O%	25%	60%	75%	90% / 100%	125% / 150%	250%+
NONE	ONE FOURTH As MUCH	HALF AS MUCH	THREE FOURTHS AS MUCH	PAY THE SAME	ONE AND A HALF TIMES AS MUCH	MORE THAN TWO AND A HALF TIMES AS MUCH

Q20 **"...cleanup would be <u>completed</u> thirty (30) years from now?"**

Q21 **"...cleanup would be <u>completed</u> one hundred (100) years from now?"**

6B. VIEWGRAPHS USED IN PRESENTATION TO THE COMMITTEE BY PROFESSOR WILLIAM D. SCHULZE

OUTLINE OF RESPONSE

1) MISSION

2) COMMODITY, CONTEXT, INFORMATION, DESIGN AND THEORETICAL QUESTIONS

3) MARKET SIZE

4) DATA ANALYSIS

MISSION

Question:

Do any non-use benefits derive from corrective actions regarding groundwater " contamination? If so, how large might they be?

Prior studies of air quality undertaken to satisfy OMB concerns:

- **Denver Brown Cloud: 8 survey design variants**
- **East Coast Visibility: 2 survey design variants**
- **Familiar vs. Exotic Commodity**

TABLE I

SUMMARY OF BROWN CLOUD SURVEY DESIGN FEATURES

		BASE		THREE		VOTING	FREQ. DIST.	3 COMMODITY COMPARISON	
	VERSION	A	B	C	D	E	F	G (WTP)	H (Choice)
RESPONSE FRAME	WTP	X	X	X	X	x	x	X	
	WTA	X	X			x			
HEALTH vs. VISIBILITY	3 Questions			X	X				
	% Split	X	X						
FORM OF THE VALUE QUESTIONS	Std. CVM	X	X	X	X		x	X	
	Voting					x			
	Choice								x
DESCRIPTION OF CHANGE IN AIR QULAITY	Average Air Quality Change	X	X	X	X	x		X	
	Freq. Distribution of Air Qual. Change						x		
CONTEXT/ INFORMATION CONTENT	Health Information		x		X				
	Extra Context					x			
	Minimal Context	X		X			x	X	X

CONCLUSIONS FROM PREVIOUS STUDIES

For a familiar commodity:

- **Voting context had no effect on values**
- **Information had little effect on total values**
- **Embedding disaggretation problems are serious**

COMMODITY: Non-use values for groundwater cleanup

- **Prior pretesting effort by Mitchell and Carson (1989) showed this to be a very difficult commodity. They found:**

  1) People know little about groundwater

  2) People rejected an existence value scenario where groundwater would never be used

- **Groundwater cleanup provided a perfect commodity to test the methodological limits of contingent valuation**

- **Complete intellectual freedom provided by OSW and OPPE**

- **Limited budget for study**

COMMODITY DEFINITION

- USEPA wanted benefits of complete groundwater cleanup

- Containment was proposed as a backup technology where complete cleanup was technologically impossible

- Complete cleanup provides a vector of services:

  (1) In some cases it provides clean water for use by the present generation (use and altruistic value)

  (2) Clean water for use by future generations (bequest value)

  (3) Knowledge that "mother earth" is not contaminated (existence value or moral value)

- Disaggregation of such values has proven difficult.

UNDER WHAT CIRCUMSTANCES MIGHT NON-USE VALUES ACTUALLY EXIST?

- **Contrast (1) Expert Benefits with (2) Subjective Benefits**

  (1) Expert Benefits are defined as the benefits experts believe to exist (e.g. Value of Life X Expert Assessment of Risk Reduction X Exposed Population). This measure excludes non-use values.

  (2) Subjective Benefits are defined as the values potentially exposed populations themselves place on environmental cleanup. These will be based on perceived risks and may include non-use values.

- **Consumer Sovereignty vs. Expert Assessments**

- **To obtain non-use values one must measure subjective values.**

SUBJECTIVE VALUES

- **Substantial subjective values have been shown to exist for NIMBY sites in a large number of studies using property values and/or contingent values where expert risks are very small**

(1) V.K. Smith and W.H. Desvousges "The Value of Avoiding a LULU: Hazardous Waste Disposal Sites" ReStat 1986.

(2) McClelland, Schulze, Hurd, "The Effect of Risk Beliefs on Property Values: A Case Study of a Hazardous Waste Site," Risk Analysis 1990.

GROUNDWATER SCENARIO DEVELOPMENT

(1) Offsite groundwater contamination of wells assures public awareness

(2) Public officials have <u>never</u> knowingly allowed contaminated water from a NIMBY site into a public water supply for fear of public outrage no matter how small the expert assessment of risk

(3) Risk information in the pretest survey caused 15% of pretest subjects to raise value for cleanup, 9% to lower value and had no effect on 76%.

(4) Risk communication has been surprisingly ineffective in real world NIMBY situations

(5) Values from this study should most appropriately be applied to sites with actual or potential offsite contamination of wells.

DEFAULT ASSUMPTIONS IF COMPLETE CLEANUP IS NOT FUNDED

- **Very large values obtained in a previous contingent valuation study of groundwater (Steven Edwards, "Option Prices for Groundwater Protection," JEEM, 1988).**

- **Default Assumptions (Fischoff and Furby, 1988)**

- **People may fear no groundwater will be available for themselves or future generations (No substitutes)**

- **Specify several default alternatives (substitutes for complete cleanup of groundwater available to current and/or future generations) to eliminate fear of "no water" such as**

  1) Home treatment

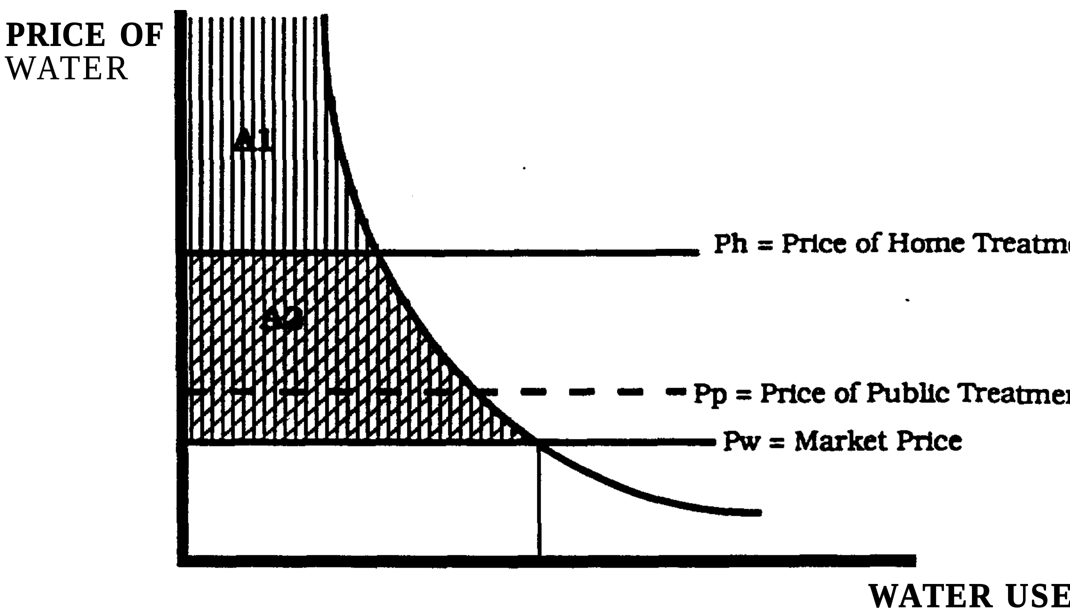
  2) Public treatment (most favored)

  3) Shortage not 10070 (surface water)

  4) Containment.

PROVISION OF SUBSTITUTE COMMODITIES

CONSIDER THE EFFECT OF SUBSTITUTES ON USE VALUE (DEMAND FOR WATER)



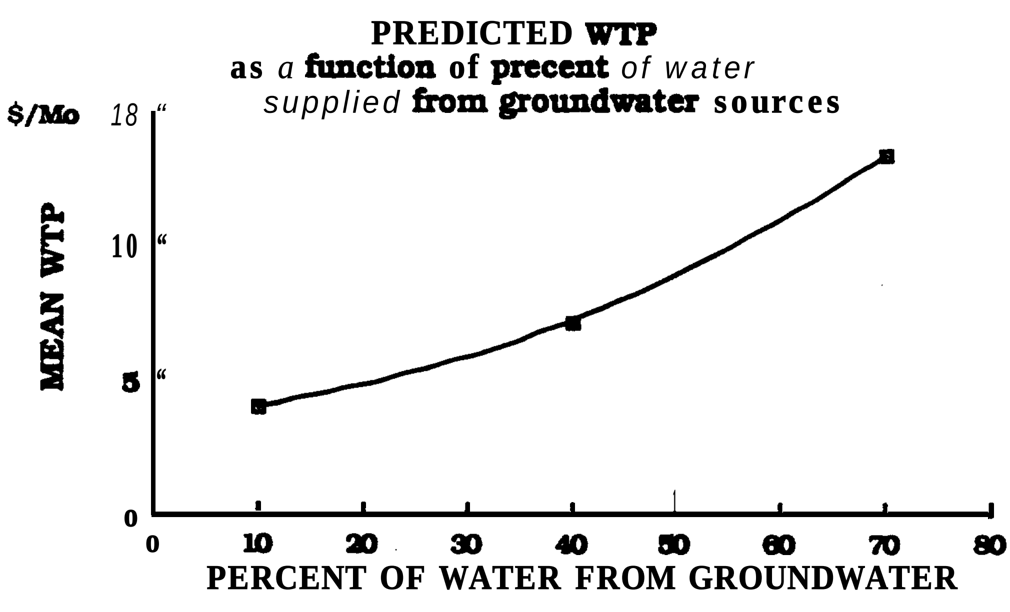
Al = CONSUMER SURPLUS WITHOUT A SUBSTITUTE

A2 = CONSUMER SURPLUS WITH A SUBSITUTE OF HOME TREATMENT

- **CONSUMER SURPLUS LOWER STILL IF Pp IS ASSUMED TO BE LESS THAN Ph**
- **ALTRUISTIC AND BEQUEST VALUES ALSO LOWERED IF RESPONDENTS ASSUME FUTURE GENERATIONS HAVE SUBSTITUTES**

IMPLIED DEMAND FOR WATER

The survey was designed so that if complete cleanup is not funded, respondents would likely assume a cheaper alternative would be funded (such as public treatment) or as a last resort, home treatment. The small value obtained for cleanup with a 70% dependence on groundwater suggests that respondents were assuming substitute alternatives were available



WHAT IF YOU DEPENDED LESS OR MORE ON GROUNDWATER

Dependency on groundwater is different for every location at which contamination has occurred. Some areas use groundwater for all of their domestic water supply while others use none. To plan new groundwater cleanup programs that could cost you money, " decision makers want to learn how much clean groundwater is worth to people like you in these different situations.

WHERE GROUNDWATER SUPPLIES 10% OF DOMESTIC WATER

Q16 Consider an imaginary leaking landfill identical to that described above except that now groundwater supplies 10*A of the domestic water supply instead of 40%. Remembering that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen how satisfied are you with water rationing as an option where water use would have to be cut by 10%?

NOT AT AU SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(3.64)

Q17 What would a complete cleanup program like that described in Q6 be worth to your household if your imaginary community faced a groundwater problem where 10% of the local domestic water supply . comes from groundwater which was contaminated and could not be used without treatment? In answering you should assume that:

- **The hypothetical situation is now one in which only 10% of the water you use in your community comes from groundwater resources. The other 90% of your water comes from surface water sources such as lakes and streams.**
- **The complete cleanup program is identical to the program described in the previous section.**

Now, of the dollar amount you would have paid just for complete groundwater cleanup when faced with 40% of your water supply contaminated, what percent would you still be willing to pay for complete groundwater cleanup if faced with 10% of your water supply coming from contaminated groundwater?

(46.51°/0)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	600/0	70%	80%	900/0	100%

WHERE GROUNDWATER SUPPLIES 70% OF DOMESTIC WATER

Q18 **Consider an imaginary leaking landfill identical to that described above except that now groundwater supplies 70% of the domestic water supply instead of 40°/0. Remembering that, on average, households use half of their domestic water outdoors, one third in the bathroom and the rest in the kitchen how satisfied are you with water rationing as an option where water use would have to be cut by 70%?**

NOT AT ALL SATISFIED						EXTREMELY SATISFIED	
1	2	3	4	5	6	7	(2.35)

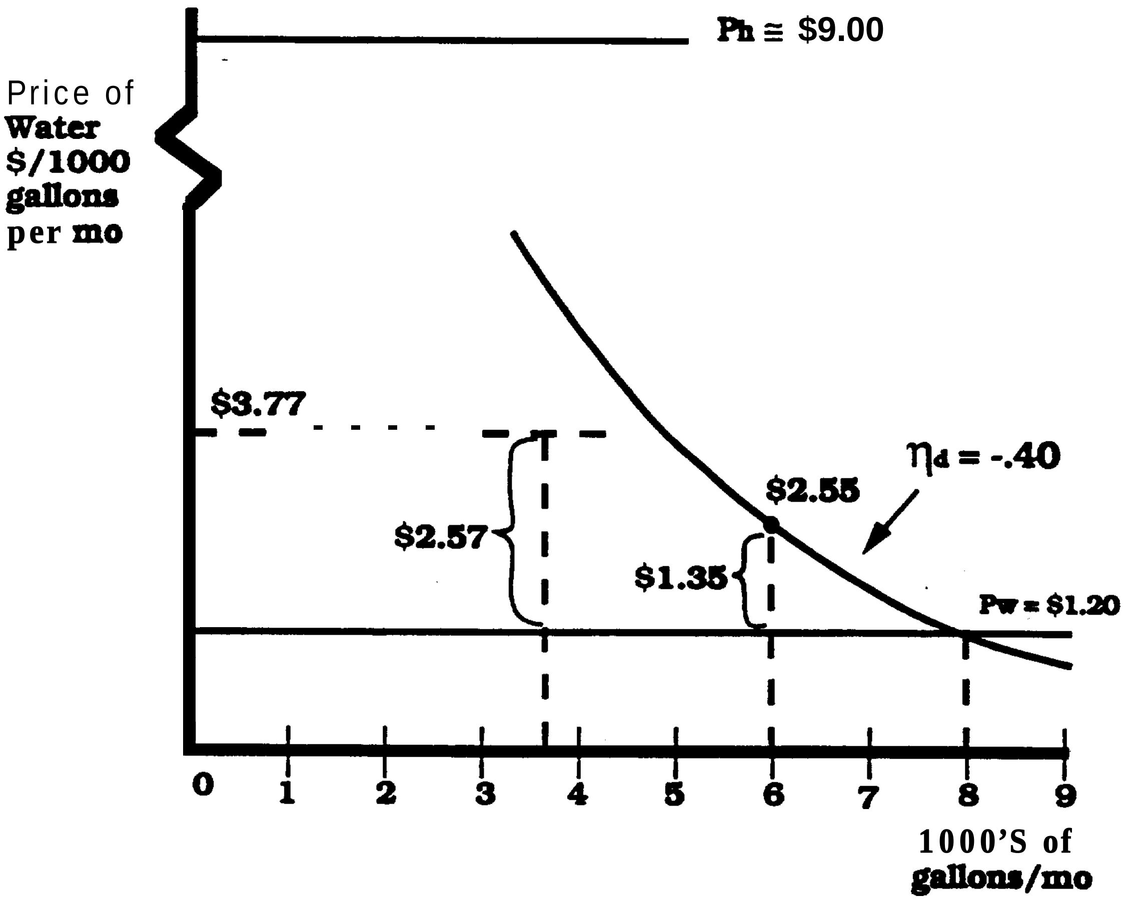
Q19 What would a complete cleanup program like that described in Q6 be worth to your household if your imaginary community faced a groundwater problem where 70% of the local domestic water supply comes from groundwater which was contaminated and could not be used without treatment? In answering you should assume that:

- **The hypothetical situation is now one in which 70% of the water you use in your community comes from groundwater resources. The other 30°/0 of your water comes from surface water sources such as lakes and streams.**
- **The complete cleanup program is identical to the program described in the previous section.**

Now, of the dollar amount you would have paid just for complete groundwater cleanup when faced with 40% of your water supply contaminated, what percent would you be willing to pay for complete groundwater cleanup if faced with 70% of your water supply coming from contaminated groundwater? (Circle the best per cent response)

(166.24%)

SAME				TWICE AS MUCH		3 TIMES AS MUCH		MORE THAN 4X AS MUCH
10OO/.	125%	150%	175%	200%	250%	300?40	350%	400%+



- Average household price and consumption from Michael Nieswiadomy " Estimating Residential Water Demand" <u>WRR</u> (1992)

- Range of Demand Elasticity Estimates

  -.11 Nieswiadomy (op. cit. 1992)
  -.57 Howe <u>W R R</u> (1982)

IMPACT OF INFORMATION/CONTEXT

- Mean household value fell from \$20.22 to \$12.20 per month
- Small samples, n≈ 40 each
- Debriefings used to explain value decrease (Table 4.2)
- Conclusion: Information on substitutes lowered values
- Emphasized substitutes in final survey design
- Conservative choices

TABLE *4.2* **SELF-REPORTED EFFECTS OF CONTEXT - DECEMBER** 1990

PRETEST

Self-reported Effects of Context from December 1990-Retest (Summary of responses to Q-47 through Q-56, Appendix B)

Percentage

Self-reported effect	9-47 Pers. exp.	Q-48 Def. of gwater.	Q-49 Speed of gwater.	Q-50 Water bill	Q-51 Buy water option
No effect	75%	82%	90%	77%	67%
Lowered value	0%	3 %	8%	8%	20%
Raised value	25%	15%	2 %	15%	13%

Percentage

Self-reported effect	9-62 Water cons.	Q-53 Private options	Q-54 Dis-counting	Q-55 W. S. T. option	Q-56 Risk commun.
No effect	72%	66%	79%	61%	7 6 %
Lowered value	13%	24%	10.5?40	34%	9 %
Raised value	15%	11?40	10.5%	5 %	15?40

VALUE PARTITIONING

(1) **Theoretical Issues (% splits)**

- **Separable Utility Function**
- **Constant Marginal Utility of Money**

(2) **Psychological Issues**

- **Do people have enough information to partition**
- **Have people thought carefully enough about issues to allow partitioning**

PORTIONING: THEORETICAL ISSUES

C_1 = Consumption by generation 1

W_1 = water consumption by generation 1

Z = amount of contaminated groundwater

U^2 = utility of next generation or others

Separable Utility Function:

(1) $U^1(C_1, W_1, Z, U^2) = V(C_1) + F(W_1) - D(Z) + A(U^2)$

Willingness to pay for complete cleanup (WTP) which provides $\Delta W_1>0$, $\Delta Z<0$ and $\Delta U^2>0$ is determined by:

(2) $U^1(C_1 - WTP, W_1 + AW, Z+AZ, U^2 + \Delta U^2) = U^1 (C_1, W_1, Z, U^2)$ **or**

(3) $-\Delta V = \Delta F - \Delta D + \Delta A$

- **With constant marginal utility of money (consumption) i.e., $\partial V/\partial C_1 =$ constant:**

$$(4) \quad \mathit{WTp} = \left(\frac{AF}{\partial V/\partial C_1}\right) + \left(\frac{\_\_\_}{\partial V/\partial C_1}\right) + \left(\frac{\Delta A}{\partial V/\partial C_1}\right)$$

Use Value	Existence Value	Bequest or Altruistic Value

- **Constant marginal utility of money is plausible since estimates of total WTP are about 1/4 of 1 % of income**

- **Separability is an empirical question but non-use values are usually assumed to be separable which makes market based measurement impossible (M.A. Freeman, "Non-Use Values in Natural Resource Damage Assessment" <u>Natural Resources Damages: Law and Economics.</u> 1992)**

PARTITIONING

PSYCHOLOGICAL ISSUES

- Pretest respondents rejected fund for future use
- Also had rejected existence value scenario
- Alternative scenarios used to educate respondents and get them to think about future generations, others' and existence value.

Option(Rating)	Benefits
Complete Cleanup (4.35)	Respondents' Use, Others' Use, Future Use, Protection of Earth
Containment (3.45)	Same as above but less certain
Public Treatment (3.74)	Respondents' Use, Others' Use
Home Treatment (2.81)	Respondents' Use

COMPONENT ALLOCATION OF TOTAL WILLINGNESS TO PAY FOR COMPLETE GROUNDWATER CLEANUP (RANDOM SUBSAMPLE

OBS	USE	ALTRUIST	BEQUEST	EXISTENCE
50	0	0	0	100
100	0	0	0	100
150	25	25	25	25
200	33	33	34	0
250	20	20	30	30
300	0	50	50	0
350	30	30	30	10
400	50	20	20	10
450	0	100	0	0
500	60	20	20	0
550	50	30	10	10
600	25	25	25	25
650	90	4	4	2
700	50	20	25	5
750	25	25	25	25
800	25	25	50	0
850	25	25	25	25
900	50	0	50	0
950	100	0	0	0
1000	33	33	34	0
1050	30	30	30	10
1100	40	30	30	0
1150	25	25	25	25
1200	0	0	100	0
1250	30	30	30	10
1300	0	0	0	100
1350	30	10	10	50
1400	33	33	34	0
1450	25	25	25	25
1500	25	25	25	25
1550	58	22	3	17
1600	70	5	20	5
1650	25	25	25	25
1700	0	0	0	100
1750	0	0	0	100
1800	50	20	20	10
1850	20	20	30	30
1900	60	30	5	5
1950	33	33	34	0
2000	0	0	0	100

OTHER DESIGN ISSUES

- Did not ask for water bill

  1) Small positive impact in self-reported effect of context on values (Table 4.2)

  2) Many people didn't know the answer

- Did not allow " don't know" as a response

  1) Little data is available to support one position or another

  2) DK response provides an easy out to difficult questions

  3) Creates econometric problems by encouraging missing observations

  4) Failure to include DK may encourage "bad answers"

  5) Need testing.

.. **DESIGN ISSUES (CONT.)**

- **Payment card**

  1) **Used approximate geometrically increasing values where upper limit is chosen not to truncate values**

  2) **Rowe et al. study (1993) using payment card values of the form $(1+X)^n$ for $n = 0, 1, . . ., N$ values shows no effect of varying X unless the Nth value (last value) truncates rhs of value distribution.**

DESIGN ISSUES (CONT.)

- **Referendum with dichotomous choice vs. payment card**

  1) **Brown Cloud study showed no impact of referendum context alone (open ended value question)**

  2) **Values very similar in preliminary pretest and final pretest of groundwater survey.**

  3) **Need more research but doubt large differences will be found between payment card and dichotomous choice because they are similar cognitive tasks. However, surprises are not uncommon.**

  4) **We know of no data based evidence to pick one approach over the other.**

6C. VIEWGRAPHS USED IN PRESENTATION TO THE COMMITTEE BY PROFESSOR GARY H. MCCLELLAND

Resolution of Statistical Issues

- Interdisciplinary confusions about mathematically equivalent terms and procedures

- Draft report for a different audience

- Appropriate Level of Precision

  — Sensitivity Analysis

  — Policy context, comparison to costs

Oversampling of NPL Households

- **EXPOSED dummy variable not significant in original analysis**

- **Test of Equality for Separate Regressions: $F(15,1967)=0.96$**

- **Search for any pairwise differences on any variables**

Exposed vs Non-Exposed Differences

— Demographically similar
INCOME, KIDS, AGE, EDUC, GENDER
no sign. cliffs
marginally more WHITE

— USE, more likely to use groundwater or be aware of it

— SOURCES, more aware of sources of local gwater contamination

— RECYCLES, more likely to be a recycler
??

— COMPLETE, MEANNCOM, & RESPONS are lower in exposed. (attitude change as a function of experience?)

— Predicted WTP
Exposed: $7.77 Non-Exposed: $6.90
n.s.

RESPONS
Responsibility Variable

- Strong predictor of WTP
  (t= 1 8.6)

- Exogenous or Endogenous

- Not available for policy

Sensitivity to its omission

Omitting RESPONS
(Box-Cox)

- λ: .15 to .13

- R^2: .30 to .18

- Other variables:

  — OTHENV no longer sign.

  — MEANNCOM now sign.

  — no sign changes

- Predicted WTP: $7.01 to $6.48

- RESPONS quadratic effect

Box-Cox Estimation

$$WTP' = \frac{WTP^{\lambda} - 1}{\lambda} \quad \text{if } \lambda \neq 0$$

$$= \log(y) \quad \text{if } \lambda = 0$$

. Handling WTP=0

— including implies $\lambda > 0$

— prior empirical results and theory suggested $\lambda \leq 0$

— so replaced WTP=0 with WTP = ε

— examine sensitivity to choice of ε

- Variability of estimate of λ

FIGURE 6.6 REDUCED WTP FOR COMPLETE GROUNDWATER CLEANUP
NATTONAL MAIL SURVEY

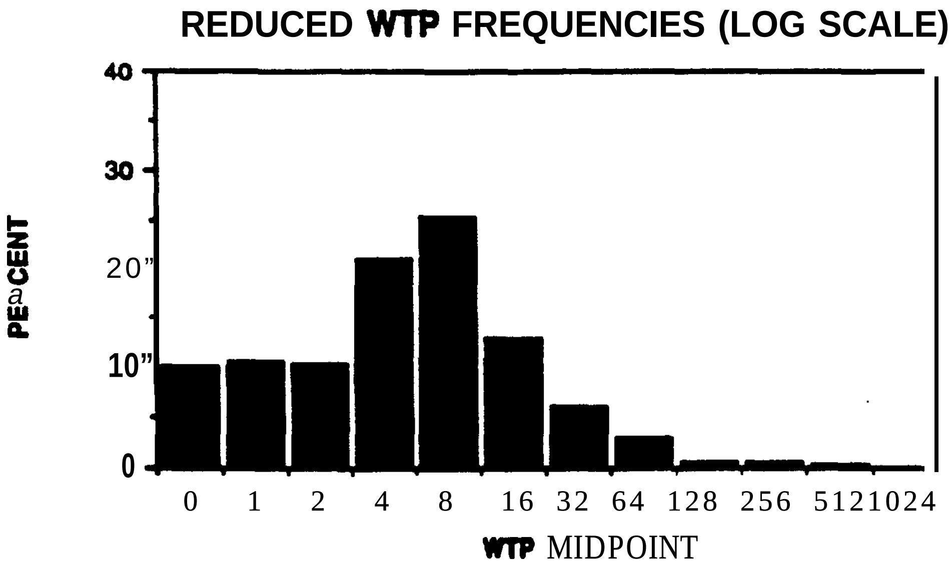
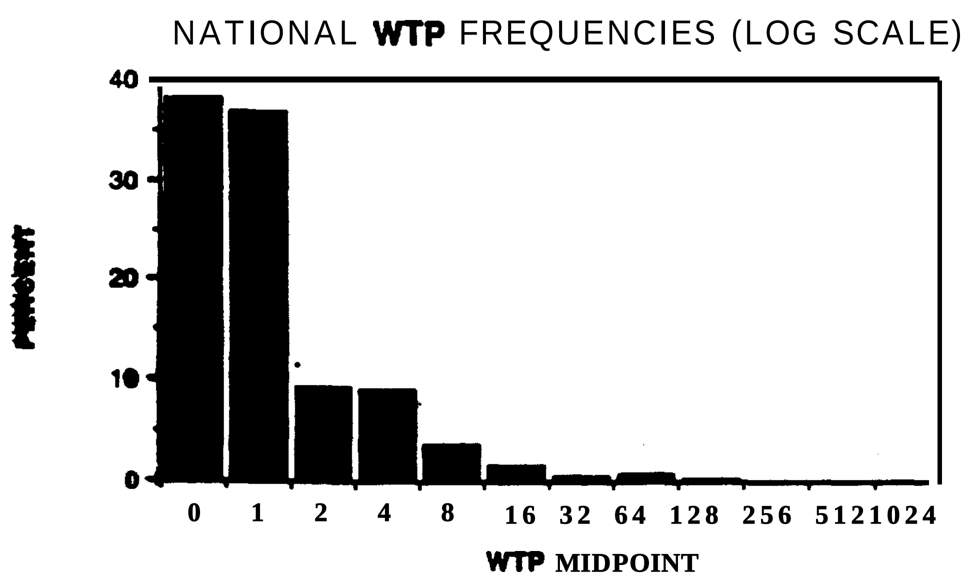


FIGURE 6.9: WTP FOR NATIONAL CLEANUP PROGRAM
NATIONAL MAIL SURVEY



Box-Cox Sensitivity

Zero set to	Mean WTP	Gee. Mean	λ [95%C.I.]	Pred. Mean WTP	Income Coef.
10$	11.711	4.49	0.15 [.1 25,.165]	7.01	3.07
1¢	11.704	3.71	0.21 [.19 S,.235]	7.15	2.99
.1¢	11.703	3.07	0.24 [.225,.255]	7.23	2.99

TABLE 7.7: LINEAR REGRESSION ON BOX-COX TRANSFORMATION OF REDWTP (a = 0.15)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Modal	2S	290 S1.93129	1162.0772S	34.272	0.0001
Error	1957	663 S7. S1024	33.90777		
C Total	1982	9S409.44153			

Root MSE	5.82304	R-square	0.3045
Dep Mean	6.90664	Adj R-sq	0.2956
C.V.	84.31072		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-5.832276	1.4531s9s7	-4.014	0.0001
INCOMEVD	1	0.026445	0.00432236	6.118	0.0001
KIDS	1	0.016927	0.31086890	0.054	0.9566
AGE	1	-0.040563	0.01002827	-4.04s	0.0001
WHITE	1	0.776703	0.4S832938	1.69S	0.0903
EDuc	1	0.382S80	0.0808S742	4.732	0.0001
GENDER	1	0.100170	0.29853243	0.336	0.7373
NORTHEAS	1	-0.3S2492	0.7s477114	-0.467	0.640S
NEWYORK	1	0.938023	0.68434316	1.371	0.1706
MIDATLAN	1	0.4S3276	0.666910S9	0.680	0.4968
SOUTH	1	-1.129931	0.63122688	-1.790	0.0736
LAKES	1	0.151642	0.6079S37S	0.249	0.8031
SOUTHWES	'	-0.706929	0.682S2417	-1.036	0.3004
MOUNTAIN	1	0.3208S1	0.824743SS	0.389	0.6973
WEST	1	-0.195098	0.71671498	-0.272	0.7855
NORTHWES		-0.043883	0.81344447	-0.054	0.9570
LANDFILL		-0.S4S102	0.32416310	-1.682	0.0928
EXPOSED	1	-0.229842	0.22S302S8	-1.020	0.3078
USE	*	0.8S0450	0.27S83740	3.083	0.0021
SOURCES	1	0.424435	0.12S82177 ,	3.373	0.0008
RECYCLES	:	0.08S447	0.06S23121	1.310	0.1904
OTHENV	1	-0.606282	0.17686973	-3.428	0.0006
GRNDWTR	1	0.469827	0.13647S64	3.443	0.0006
COMPLETE	1	0.35824S	0.077S2901	4.621	0.0001
MEANNCOM	1	0.223914	0.12073641	1.8SS	0.0638
RESPONS	1	1.S92300	0.08s80801	18.557	0.0001

Variable	Label	N	Mean	Std Dev
REDWTP	reduced wtp	231S	11.5783S85	2S.9979281
PREDWTP	pred in dollars	1983	7.0077342	5.2925489

FIGURE 1:

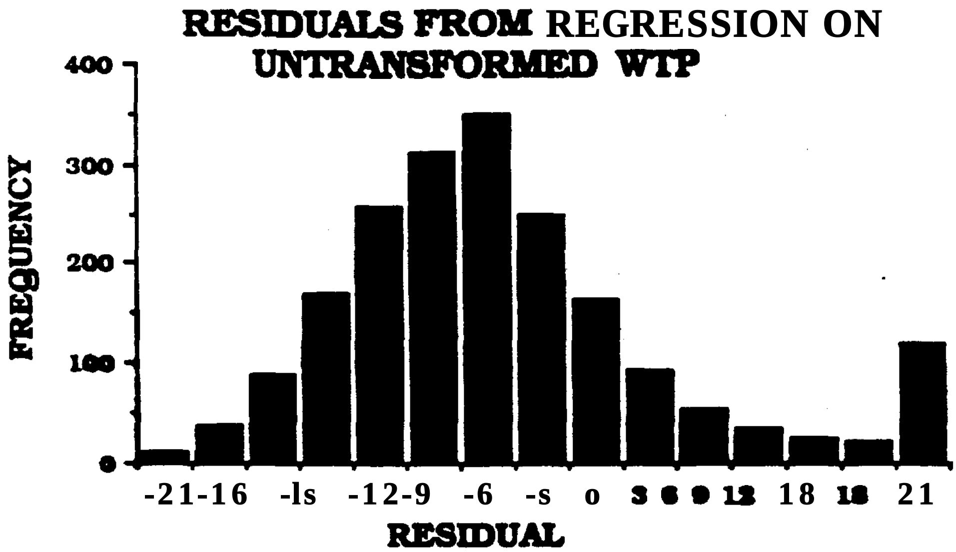
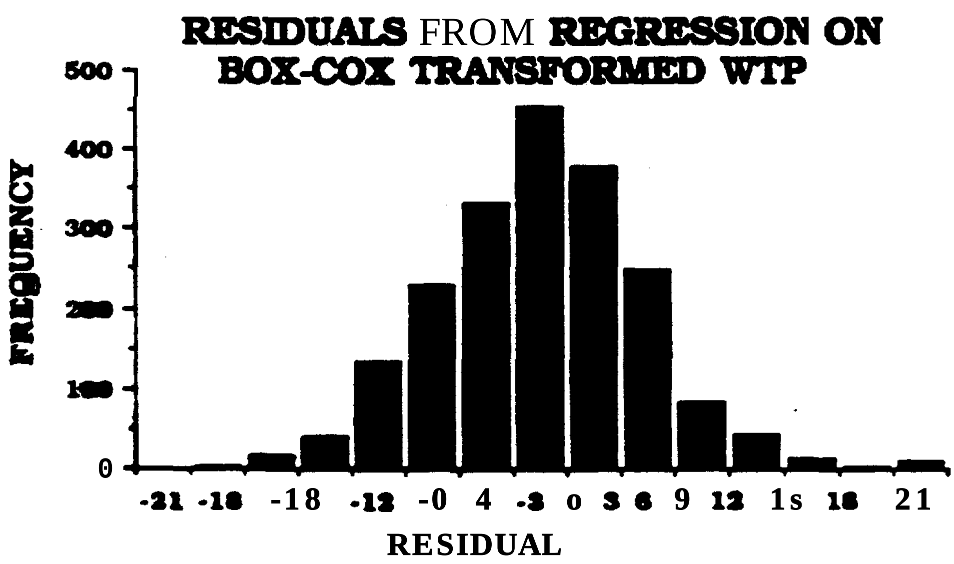


FIGURE 2:



Version D

(1 O%, 40%, 70% Shortages)

- **Separate analysis for this group?**

  — Yes, and it made no difference on percent splits

- **Correlated errors from multiple responses**

$$WTP = \beta_0 + \beta_1(\%Short) + \beta_2(\%Short)^2 + \varepsilon_i$$

Estimated β_0 for each person

3 eqns and 3 unknowns for each person

Solves correlated error problem

TABLE 7.21: COMPARISON OF DIFFERENT APPROACHES TO ESTIMATING NON-USE VALUES (for predicted values)

METHOD	BEQUEST PLUS EXISTENCE	STANDARD DEVIATION	N
PERCENT SPLITS	3.49	3.97	1126
SCENARIO DIFFERENCES	2.81	3.11	345
EXTRAPOLATION	3.54	5.86	344

Estimate Reliability within Respondent

- $\hat{\beta}_0$ vs. %splits

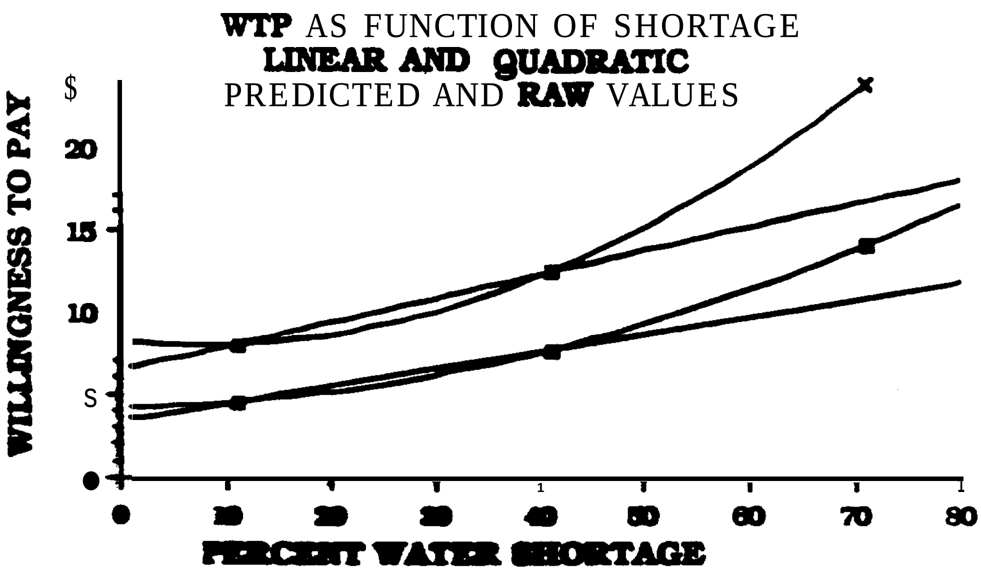
  Mean cliff = \$.08
  n = 354
  t = 0.78 n.s.

- Scenario Diff vs. %splits

  Mean cliff = \$-1.62
  n = 337
  t = -2.93 $p < .005$

  — public treatment option may contain bequest value

  — therefore, scenario difference may underestimate non-use value



COMPARISON OF DIFFERENT APPROACHES TO ESTIMATING NON-USE VALUES (FOR PREDICTED VALUES)

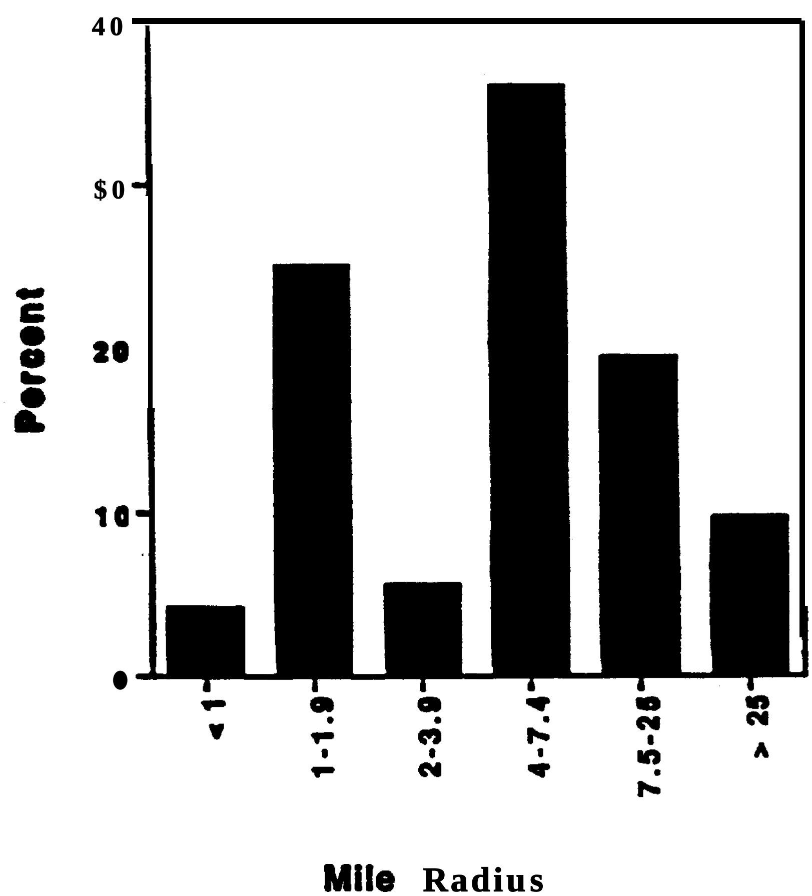
METHOD	MEAN ESTIMATED NON-USE VALUE	STANDARD DEVIATION	n
PERCENT SPLITS	3.94	3.97	1126
SCENARIO DIFFERENCES	2.81	3.11	345
EXTRAPOLATION (QUADRATIC)	3.54	5.86	344
EXTRAPOLATION (LINEAR)	2.89	4.64	344

YOUR COMMUNITY

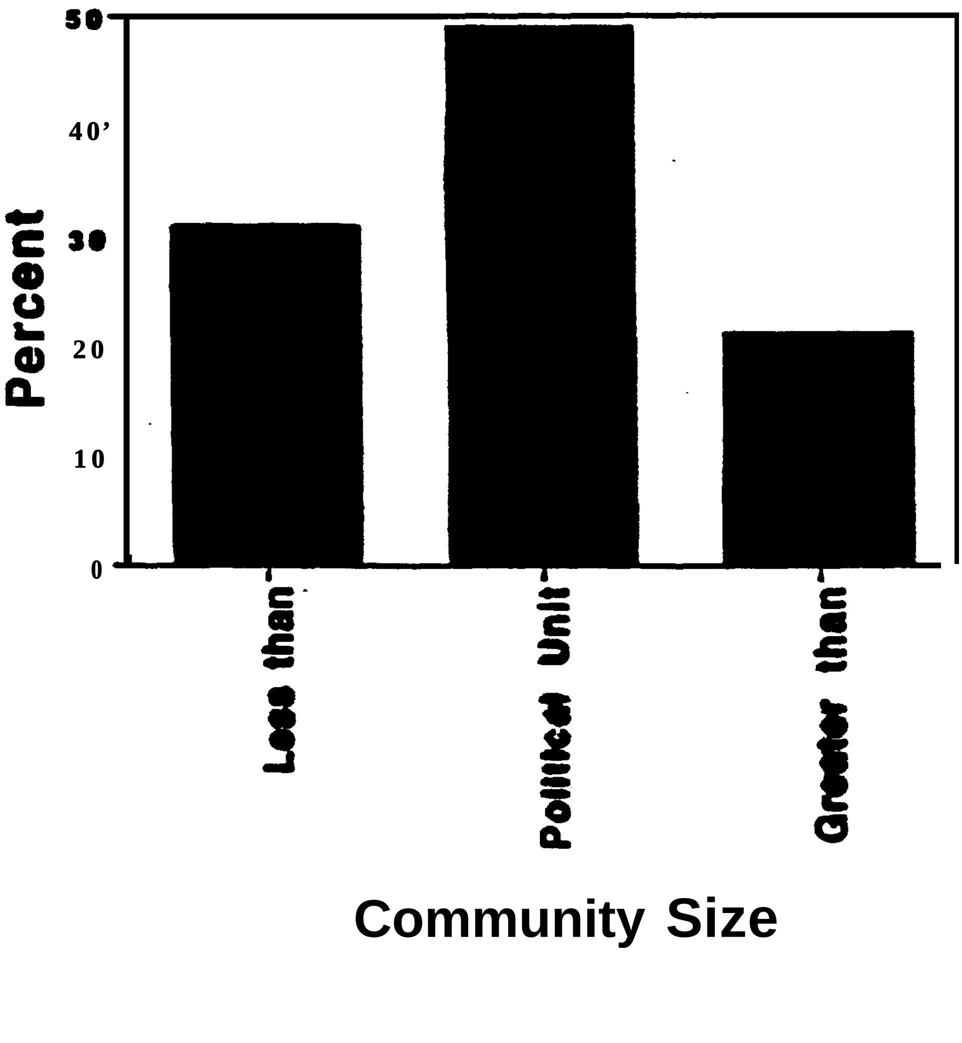
Q1 8 **Different** people have different ideas about **the size of their community. Among the different descriptions of the size of a community** that are **listed below, please circle the letter next to the one that most closely describes what you think of as defining the size of your own community.**

A. **Just my block.**
B. **Just my block and the next two blocks in any direction.**
C. **The area that I could drive from my house to the edge of in five minutes in city traffic (not at rush hour).**
D. **The area that I could drive from my house to the edge of in fifteen minutes in city traffic (not at rush hour).**
E **The area that I could drive from my house to the edge of in thirty minutes in city traffic (not at rush hour).**
F. **The entire city in which I live**
G **The entire county in which I live**
H. **The entire state of Colorado.**
I. **The entire nation.**
J. **Other. Please describe** _______________

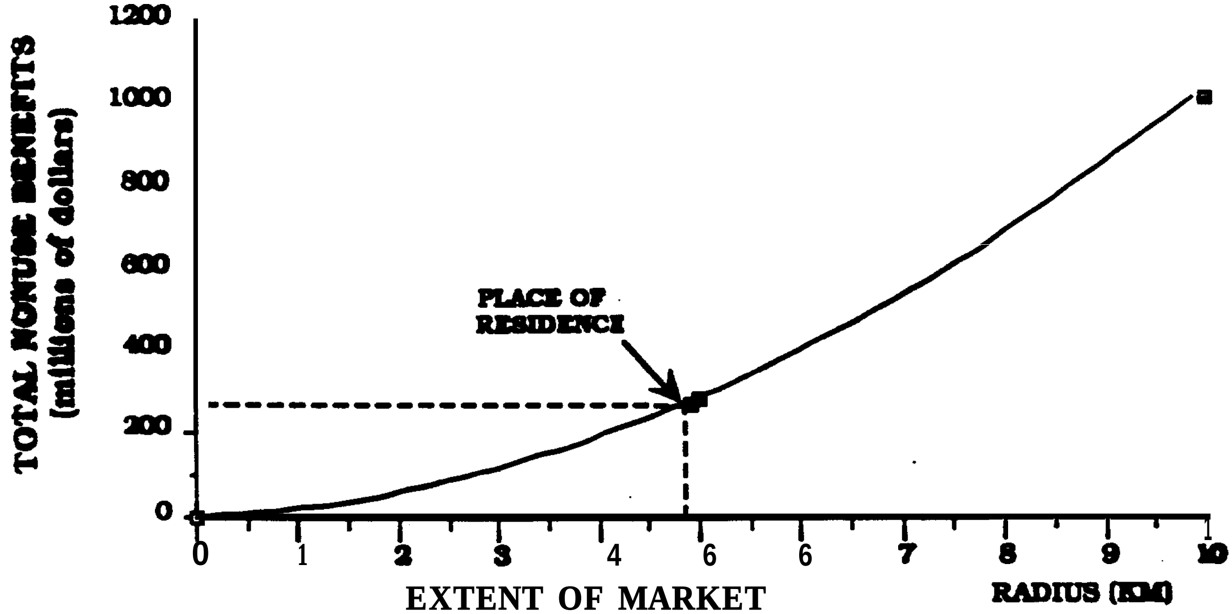
Community Size Definitions
for Groundwater WTP



Community Size Definitions for Groundwater WTP



TOTAL NONUSE BENEFITS AS A FUNCTION OF EXTENT OF MARKET



MARKET SIZE	TOTAL NONUSE BENEFITS (millions of 1992 dollars)
PLACE OF RESIDENCE	276
5 KM	283
10 KM	1,012